



Our reference: 3001469/2007/RP_001/RH/AC/REV02

7 November 2007

Mr James Flockton
Byron Shire Council
70-90 Station Street
MULLUMBIMBY NSW 2482

Dear James,

STORMWATER DRAINAGE SYSTEM DESIGN FOR UPGRADE OF LIGHTHOUSE ROAD, BYRON BAY, NEW SOUTH WALES

Further to our site inspection on 20 September 2007 SMEC have completed the assessment and the design of the stormwater drainage system at the above mentioned location.

INTRODUCTION

We understand that the upgrade will comprise of road shoulder upgrade on the northern side of Lighthouse Road. The 385-metres-long upgrade will extend from the intersection of the Lighthouse Road with Massinger Street and include construction of new kerb and gutter, pavement sealing and drainage. The proposed drainage system will consist of pits and pipes.

Following our initial assessment and site inspection, it was identified that due to the existing downstream system capacity, a new additional drainage will be required along Massinger Street to carry the additional concentrated flow from new Lighthouse Road drainage system.

We also understand that there are existing 250mm diameter PVC pipe, 300mm diameter PVC pipe and 350mm diameter RCP located upstream location of the Lighthouse Road Upgrade. The flow derived from these pipes into the proposed drainage system will be assessed as a separate option.

DESIGN REFERENCE AND CRITERIA

Design and analysis were undertaken in accordance with the following guidelines:

- Engineers Australia Guideline – Australian Rainfall and Runoff (1998); and
- Road Traffic Authority (RTA) – Road Design Guide.

The design and analysis were carried out to accommodate a minor event of 1 in 10 years ARI design flow and a major event of 1 in 100 years ARI design flow.

RESULT OF ANALYSIS AND DESIGN

Within the assessment, two main design options were carried out:

- Option 1 – Lighthouse Road Drainage system
- Option 2 – Lighthouse Road Drainage system with additional upstream flow

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ACN 065 475 149 SMEC INTERNATIONAL PTY LIMITED ACN 065 440 619 SMEC OPERATIONS PTY LIMITED ACN 065 474 428 SMEC SERVICES PTY LIMITED
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Option 1 – Lighthouse Road Drainage system

Following SMEC's assessment and discussion with Council, the design was undertaken to cater only for road surface runoff. Result of our design is shown in Figure 1 with pit and pipe details provided in Attachment 1.

As part of our design, it is identified that the following works will also be required to ensure the performance of the drainage system:

- install pre-cast headwall to suit 600mm diameter RCP downstream of Pipe No.10;
- construct RTA type SO/concrete dish drain above new pipe(s) at Massinger Street;
- maintain the existing downstream grass-lined-channel profile to provide base width of 1.5m with a minimum depth of 0.5m and a side batter of 1V:2H;
- install 4m wide x 6 m long x 170mm thick RENO Mattress, or approved equivalent downstream of proposed headwall.

Our assessment using DRAINS software indicated that the system with the abovementioned arrangement would contain the design storm of:

- 1 in 10 years ARI (minor storm) for critical rainfall duration of 5 minutes
- 1 in 100 years ARI (major storm) for critical rainfall duration of 60 minutes (1 hour)

A design cost estimate with a twenty (20) percent contingency was prepared and it indicates that a total of **\$244,500** would be required for construction of this option. Details of the cost estimate are provided at Attachment 2.

Option 2 - Lighthouse Road Drainage system with Additional Upstream Flow

Option 2 provides a design and an assessment of drainage system to allow additional flow from the existing pipes. Result of our design is shown in Figure 2 with pit and pipe details provided in Attachment 3.

In addition to pit and pipe design, the following works will also be required for the drainage system:

- install a proposed pre-cast headwall for 2/900mm diameter RCP downstream of Pipe no 12;
- construct RTA type SO/concrete dish drain above new pipe(s) at Massinger Street;
- maintain the existing downstream grass-lined-channel profile to provide a base width of 3.0m with a minimum depth of 0.5m and a side batter of 1V:2H;
- install 4m wide x 6 m long 170mm thick RENO Mattress or approved equivalent at downstream location of proposed headwall.

Our assessment using DRAINS software indicated that the system with the abovementioned arrangement would contain the design storm of:

- 1 in 10 years ARI (minor storm) for critical rainfall duration of 60 minutes (1 hour)
- 1 in 100 years ARI (major storm) for critical rainfall duration of 60 minutes (1 hour)

Furthermore, a cost estimate with a twenty (20) percent contingency was prepared and it indicates that a total of **\$628,500** would be required for construction of this option. Details of the cost estimate are provided at Attachment 4.

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DESIGN EXCLUSION AND RECOMMENDATION

SMEC have not carried out detailed design associated with the drainage system and kerb/gutter arrangement.

The following recommendation shall be considered by Council engineer in preparing the construction details:

- Kerb and gutter arrangement should be design to cater for run-off from the adjacent cycleway.
- Details of drainage pit and pipes should be in accordance with RTA standard drawings/guidelines.

FLOOD IMPACT ASSESSMENT OF PROPOSED DRAINAGE SYSTEM

Following the completion of the design and as nominated in SMEC's proposal, a flood impact assessment was carried out of the proposed drainage system Option 1.

The flood behaviour within the vicinity of proposed drainage was modelled using TUFLOW (a 2-dimensional hydrodynamic modelling software) incorporating ESTRY (a 1D hydrodynamic modelling software). The existing calibration model for Belongil Creek Flood Study was used in determining the flood extent within the proposed drainage system corridor. The model, which was based on flood event on April 1974, April 1984 and June 2003, was prepared by SMEC for Byron Shire Council.

In assessing the impact of the proposed drainage system during the design event (100 years ARI) two standard ocean condition, 20 AEP ocean level and 100 AEP ocean level, were assessed in this flood study. For design rainfall event of 100 year ARI, the 20 AEP ocean level has been considered to have a higher probability of occurrence; however to get an understanding of risk for a 100 year planning period, the 100 AEP ocean level was also considered in this assessment.

As a result, four scenarios were assessed in determining impact of the proposed development:

- Scenario 1: model of original condition during 1 in 100 years ARI event with a 20 years AEP ocean level at Clarkes Beach outlet and Belongil Creek outlet;
- Scenario 2: model to include proposed development for 1 in 100 years ARI event with a 20 years AEP ocean level at Clarkes Beach outlet and Belongil Creek outlet
- Scenario 3: model of original condition during 1 in 100 years ARI event with a 100 years AEP ocean level at Clarkes Beach outlet and Belongil Creek outlet
- Scenario 4: model to include proposed development for 1 in 100 years ARI event with a 100 years AEP ocean level at Clarkes Beach outlet and Belongil Creek outlet

Results of the flood simulation are shown in Figure 003, Figure 004, Figure 005 and Figure 006.

The result of our assessment indicated that there is no significant impact from the proposed stormwater drainage system on the flood level. Flood afflux was documented at the downstream of the drainage and shown in Table 001. In summary the afflux was identified to be neglectable (less or equal to 0.05 m).

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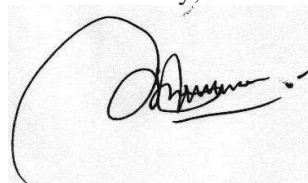
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TABLE 001 FLOOD LEVEL COMPARISON

Node	Indicative Location	1 in 100 years ARI, 20 AEP ocean level			1 in 100 years ARI, 100 AEP ocean level		
		Scenario 1 (RL m AHD)	Scenario 2 (RL m AHD)	Afflux (m)	Scenario 3 (RL m AHD)	Scenario 4 (RL m AHD)	Afflux (m)
1	Upstream of intersection between Lighthouse Road and Patterson Street	10.538	10.538	0.000	10.538	10.538	0.000
2	Intersection between Patterson Street and Kipling Street	5.770	5.770	0.000	5.770	5.770	0.000
3	Massinger Street	3.570	3.571	0.001	3.575	3.570	-0.005
4	5 Massinger Street	4.144	4.144	0.000	4.145	4.144	-0.001
5	Intersection between Massinger Street and Kipling Street	3.252	3.250	-0.002	3.254	3.252	-0.002
6	Crowns Land, Copper Street	3.225	3.224	-0.001	3.228	3.225	-0.003
7	Intersection between Cowper Street and Lawson Street	3.221	3.220	-0.001	3.224	3.221	-0.003

Should you have any queries or require further information, please do not hesitate to contact the undersigned or Andrew Celona.

Yours sincerely,



Rainier Haryanto
Project Engineer

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FIGURE 001 – DRAINAGE DESIGN LAYOUT – OPTION 1

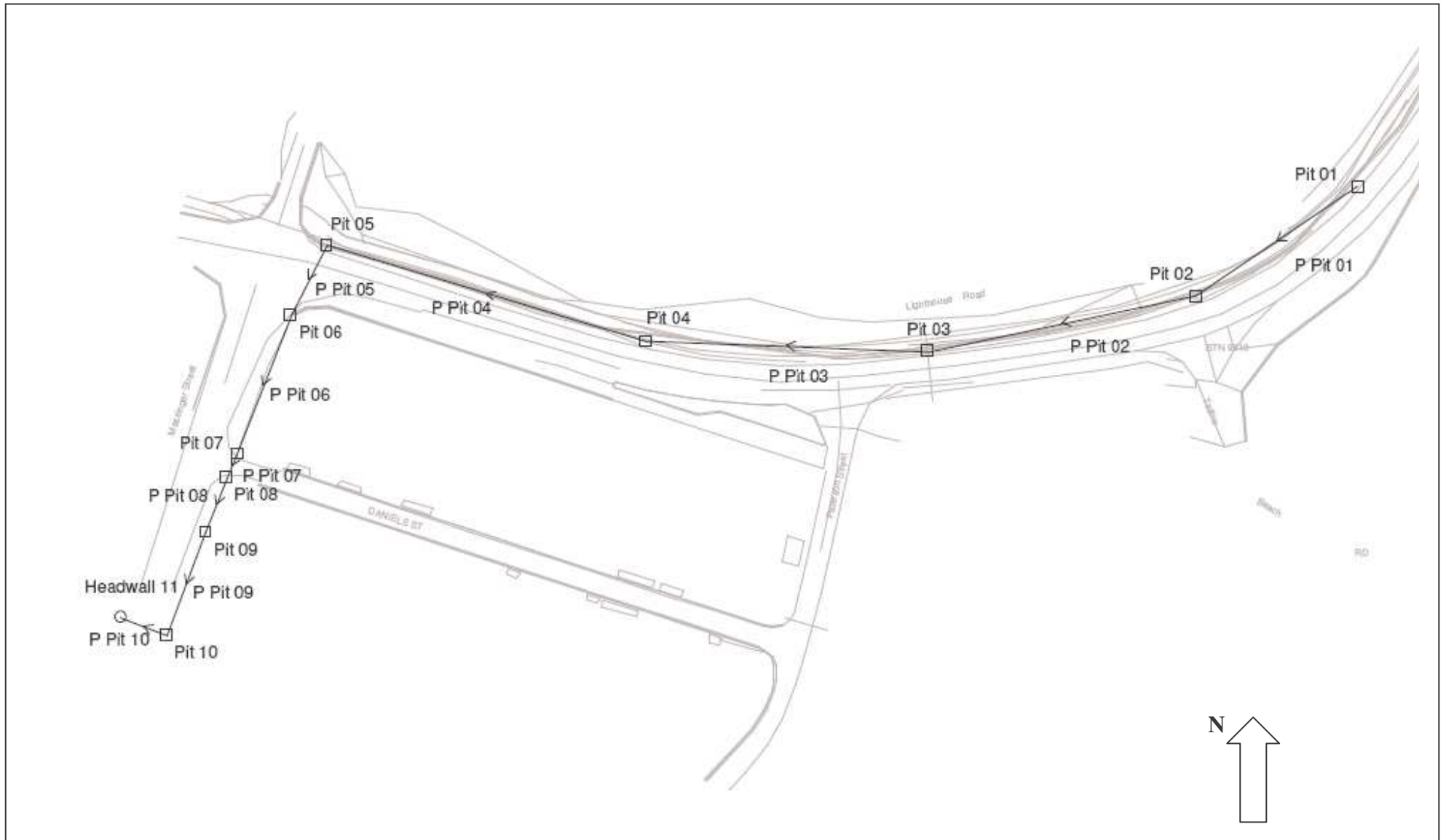
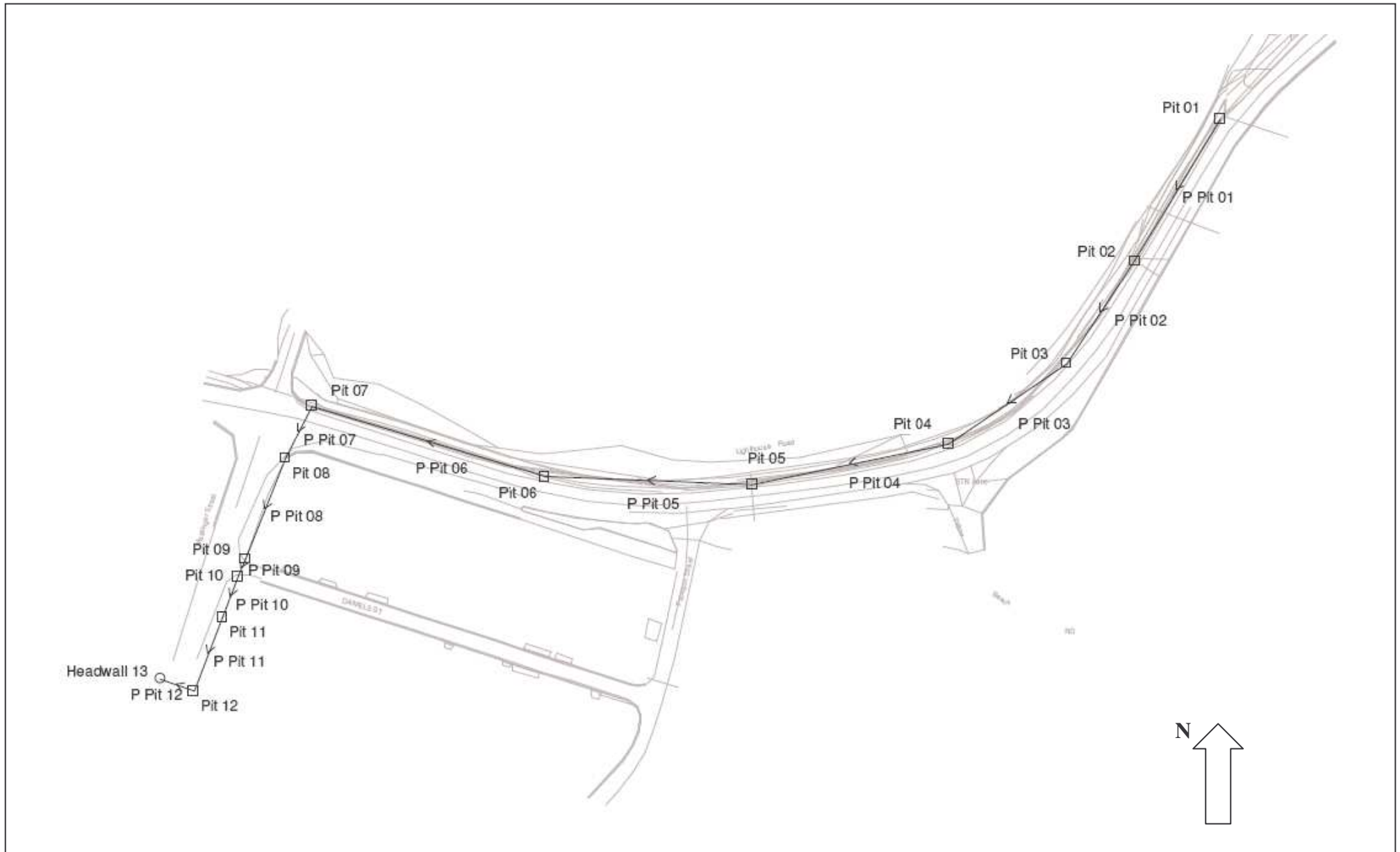


FIGURE 002 – DRAINAGE DESIGN LAYOUT – OPTION 2





FLOOD LEVEL LEGEND (RL in metres)

0.00 to 1.00
1.00 to 2.00
2.00 to 3.00
3.00 to 4.00
4.00 to 5.00
5.00 to 6.00
6.00 to 7.00
7.00 to 8.00
8.00 to 9.00
9.00 to 10.00
10.00 to 11.00

LEGEND

CADASTRE
COWPER STREET DRAINAGE SYSTEM
JONSTON STREET DRAINAGE SYSTEM
FLOOD LEVEL (M IN RL AHD)
FLOW DIRECTION



PROJECT NO. 3001469
LIGHTHOUSE ROAD UPGRADE-
DRAINAGE SYSTEM DESIGN
FLOOD IMPACT ASSESSMENT

FIGURE 003
FLOOD EXTENT MAP AT VICINITY OF
PROPOSED DRAINAGE SYSTEM
SCENARIO 1 - 100 YEARS ARI EVENT WITH
20 YEARS AEP OCEAN LEVEL



FLOOD LEVEL LEGEND (RL in metres)

0.00 to 1.00
1.00 to 2.00
2.00 to 3.00
3.00 to 4.00
4.00 to 5.00
5.00 to 6.00
6.00 to 7.00
7.00 to 8.00
8.00 to 9.00
9.00 to 10.00
10.00 to 11.00

LEGEND

CADASTRE
COWPER STREET DRAINAGE SYSTEM
JONSTON STREET DRAINAGE SYSTEM
4.144 FLOOD LEVEL (M IN RL AHD)
FLOW DIRECTION



PROJECT NO. 3001469
LIGHTHOUSE ROAD UPGRADE-
DRAINAGE SYSTEM DESIGN
FLOOD IMPACT ASSESSMENT

FIGURE 004
FLOOD EXTENT MAP AT VICINITY OF
PROPOSED DRAINAGE SYSTEM
WITH THE SYSTEM
SCENARIO 2 - 100 YEARS ARI EVENT WITH
20 YEARS AEP OCEAN LEVEL



FLOOD LEVEL LEGEND (RL in metres)

0.00 to 1.00
1.00 to 2.00
2.00 to 3.00
3.00 to 4.00
4.00 to 5.00
5.00 to 6.00
6.00 to 7.00
7.00 to 8.00
8.00 to 9.00
9.00 to 10.00
10.00 to 11.00

LEGEND

CADASTRE
COWPER STREET DRAINAGE SYSTEM
JONSTON STREET DRAINAGE SYSTEM
4.144 FLOOD LEVEL (M IN RL AHD)
FLOW DIRECTION



PROJECT NO. 3001469
LIGHTHOUSE ROAD UPGRADE-
DRAINAGE SYSTEM DESIGN
FLOOD IMPACT ASSESSMENT

FIGURE 005
FLOOD EXTENT MAP AT VICINITY OF
PROPOSED DRAINAGE SYSTEM
SCENARIO 3 - 100 YEARS ARI EVENT WITH
100 YEARS AEP OCEAN LEVEL



FLOOD LEVEL LEGEND (RL in metres)

0.00 to 1.00
1.00 to 2.00
2.00 to 3.00
3.00 to 4.00
4.00 to 5.00
5.00 to 6.00
6.00 to 7.00
7.00 to 8.00
8.00 to 9.00
9.00 to 10.00
10.00 to 11.00

LEGEND

CADASTRE
COWPER STREET DRAINAGE SYSTEM
JONSTON STREET DRAINAGE SYSTEM
4.144 FLOOD LEVEL (M IN RL AHD)
FLOW DIRECTION



PROJECT NO. 3001469
LIGHTHOUSE ROAD UPGRADE-
DRAINAGE SYSTEM DESIGN
FLOOD IMPACT ASSESSMENT

FIGURE 006
FLOOD EXTENT MAP AT VICINITY OF
PROPOSED DRAINAGE SYSTEM
WITH THE SYSTEM
SCENARIO 4 - 100 YEARS ARI EVENT WITH
100 YEARS AEP OCEAN LEVEL

ATTACHMENT 001: PIT AND PIPE DETAILS - OPTION 1

PIT DETAILS

Pit No	Pit Type	Approximate Setout Location in ISG Coordinates		Approximate Surface Level (m in RL AHD)
		Easting (m)	Northing (m)	
1	RTA Pit type SA1 (Type 2)	361007.856	1830086.509	14.44
2	RTA Pit type SA1 (Type 2)	360966.66	1830058.508	13.13
3	RTA Pit type SA1 (Type 2)	360898.225	1830044.39	10.91
4	RTA Pit type SA1 (Type 2)	360826.029	1830047.084	8.39
5	RTA Pit type SA1 (Type 2)	360744.85	1830071.59	5.19
6	RTA Pit type SO2 (Double Grate)	360735.741	1830053.641	4.39
7	RTA Pit type SO2 (Double Grate)	360721.796	1830018.238	3.79
8	RTA Pit type SO1 (Single Grate)	360719.304	1830012.183	3.70
9	RTA Pit type SO1 (Single Grate)	360713.843	1829998.232	3.69
10	RTA Pit type SO2 (Double Grate)	360703.892	1829972.088	3.68

PIPE DETAILS

Pipe No	Pipe Connection		Pipe Size (DN)	Pipe Type and Class	Design Grade (%)	Approximate Length (in m)	Approximate Invert Level (in m RL AHD)	
	From	To					Upstream	Downstream
1	Pit 01	Pit 02	375	RRJ RCP - Class 2	1.89	50.25	12.839	11.887
2	Pit 02	Pit 03	375	RRJ RCP - Class 2	2.50	69.98	11.837	10.087
3	Pit 03	Pit 04	375	RRJ RCP - Class 2	3.78	72.59	10.037	7.292
4	Pit 04	Pit 05	375	RRJ RCP - Class 2	4.00	84.80	7.242	3.850
5	Pit 05	Pit 06	450	RRJ RCP - Class 2	2.75	20.13	3.800	3.246
6	Pit 06	Pit 07	525	RRJ RCP - Class 2	1.90	38.05	3.196	2.473
7	Pit 07	Pit 08	600	RRJ RCP - Class 2	1.50	6.55	2.423	2.325
8	Pit 08	Pit 09	600	RRJ RCP - Class 2	1.00	21.48	2.275	2.060
9	Pit 09	Pit 10	600	RRJ RCP - Class 2	1.00	21.48	1.985	1.771
10	Pit 10	Headwall	600	RRJ RCP - Class 2	1.00	12.50	1.721	1.596

Attachment 002:
COST ESTIMATE
Option 1

Item	Description of Works	Quantity	Unit	Rate	Amount
1 GENERAL					
1.1	Site establishment, setting up, setting out works, insurances, fees.	Item	Lump Sum	\$ 10,000	\$ 10,000
1.2	Liaison with relevant Services Authorities and locate Services	Item	Lump Sum	\$ 1,000	\$ 1,000
1.3	Prepare and Implement Traffic Management Plan	Item	Lump Sum	\$ 5,000	\$ 5,000
1.4	Prepare and Implement Environmental Management System including Sedimentation Control	Item	Lump Sum	\$ 3,000	\$ 3,000
1.5	Provision of temporary site facilities	Item	Lump Sum	\$ 2,500	\$ 2,500
2 PRELIMINARY					
2.1	Clearing and Grubbing	Item	Lump Sum	\$ 1,800	\$ 1,800
3 EARTHWORKS					
3.1	Removal and stockpiling of topsoil (nominally 100mm)	1,400	m ²	\$ 1	\$ 1,540
3.2	Excavate, haul and dispose within 250m from site of material from trench area in accordance to Contract Drawings	1,000	BCM	\$ 50	\$ 50,000
3.3	Excavate and trim to design profile channel at location shown in Contract Drawings (Provisional Quantities)	100	BCM	\$ 50	\$ 5,000
3.4	Extra over item for removal of unsuitable material (Provisional Quantities)	100	BCM	\$ 80	\$ 8,000
3.5	Supply, load, and compact selected material for Bed and Haunch zone (type HS support)	90	CCM	\$ 67	\$ 6,030
3.6	Supply, load, and compact select material for Side zone and Overlay zone (Type HS support)	225	CCM	\$ 67	\$ 15,075
3.7	Win from borrow, load, and compact general backfill material for Overlay zone	220	CCM	\$ 45	\$ 9,900
4 STORMWATER PITS AND PIPES					
4.1	Supply, place and secure new pit in accordance with Contract Drawings:				
	a) RTA pit type SA1	5	No.	\$ 1,100	\$ 5,500
	b) RTA pit type SO1	2	No.	\$ 995	\$ 1,990
	c) RTA pit type SO2	3	No.	\$ 977	\$ 2,932
4.2	Supply and place RCP class 2 RRJ in accordance with Contract Drawings:				
	a) 375mm dia. Pipe	271	m	\$ 56	\$ 15,176
	b) 450mm dia. Pipe	20	m	\$ 73	\$ 1,460
	c) 525mm dia. Pipe	37	m	\$ 84	\$ 3,108
	d) 600mm dia. Pipe	32	m	\$ 100	\$ 3,200
4.3	Supply, place and secure a precast headwall for 1/600mm dia. RCP at the location shown in Contract Drawings.	1	No.	\$ 410	\$ 410
4.4	Cast Insitu Kerb and Gutter type SA along Lighthouse Road upgrade (including connection to pits)	70	m ³	\$ 450	\$ 31,500
4.5	Cast Insitu Dish drain type SO along Massinger Street (including connection to pits)	15	m ³	\$ 450	\$ 6,750
4.6	Fabricate, supply and install drainage grate for SA1 pit type	5	No.	\$ 535	\$ 2,675
4.7	Fabricate, supply and install drainage grate for SO1 pit type	2	No.	\$ 580	\$ 1,160
4.8	Fabricate, supply and install drainage grate for SO2 pit type	3	No.	\$ 965	\$ 2,895
5 DRAINAGE STRUCTURES					
5.1	Supply, place and secure BIDIM A34 geotextile underneath rock mattresses at downstream location of 600mm dia. precast headwall	30	m ²	\$ 8	\$ 240
5.2	Supply, place and secure 170mm thick RENO rock mattresses at the downstream location of 600mm dia. precast headwall	24	m ²	\$ 45	\$ 1,080
6 PAVEMENT (BY OTHERS)					
7 VEGETATION					
7.1	Topsoil and seed	400	m ²	\$ 1	\$ 280
8 MISCELLANEOUS					
8.1	Geotechnical inspections and certificate of compliance for fill materials.	Item	Lump Sum	\$ 2,500	\$ 2,500
8.2	Re-instate Existing Driveways	Item	Lump Sum	\$ 2,000	\$ 2,000
				TOTAL COST	\$ 203,701
				CONTINGENCY (20%)	\$ 40,740
				GRAND TOTAL	\$ 244,441

Notes : BCM = Bank Cubic Metres
CCM = Compacted Cubic Metres

ATTACHMENT 003: PIT AND PIPE DETAILS - OPTION 2

PIT DETAILS

Pit No	Pit Type	Approximate Setout Location in ISG Coordinates		Approximate Surface Level (m in RL AHD)
		Easting (m)	Northing (m)	
1	RTA pit type SA5 (Type 9)	361061.234	1830171.902	16.14
2	RTA pit type SA5 (Type 9)	361031.545	1830122.419	14.85
3	RTA pit type SA2 (Type 5)	361007.856	1830086.509	14.44
4	RTA pit type SA2 (Type 5)	360966.66	1830058.508	13.13
5	RTA pit type SA2 (Type 5)	360898.225	1830044.39	10.91
6	RTA pit type SA2 (Type 5)	360826.029	1830047.084	8.39
7	RTA pit type SA2 (Type 5)	360744.85	1830071.59	4.92
8	RTA pit type SO2 (Double Grate)	360735.741	1830053.641	4.39
9	RTA pit type SO2 (Double Grate)	360721.796	1830018.238	3.79
10	RTA pit type SO1 (Single Grate)	360719.304	1830012.183	3.70
11	RTA pit type SO1 (Single Grate)	360713.843	1829998.232	3.69
12	RTA pit type SO2 (Double Grate)	360703.892	1829972.088	3.68

PIPE DETAILS

Pipe No	Pipe Connection		Pipe Size (DN)	Pipe Type and Class	Design Grade	Approximate Length (in m)	Approximate Invert Level	
	From	To					Upstream	Downstream
1	Pit 01	Pit 02	2/750	RRJ RCP - Class 2	2.30	57.71	14.397	13.070
2	Pit 02	Pit 03	2/750	RRJ RCP - Class 2	1.00	43.02	13.020	12.590
3	Pit 03	Pit 04	2/750	RRJ RCP - Class 2	1.67	50.25	12.540	11.703
4	Pit 04	Pit 05	2/750	RRJ RCP - Class 2	3.11	69.98	11.653	9.479
5	Pit 05	Pit 06	2/900	RRJ RCP - Class 2	3.61	72.59	9.429	6.812
6	Pit 06	Pit 07	2/900	RRJ RCP - Class 2	4.00	84.80	6.762	3.370
7	Pit 07	Pit 08	2/900	RRJ RCP - Class 2	2.55	20.13	3.320	2.806
8	Pit 08	Pit 09	2/900	RRJ RCP - Class 2	1.90	38.05	2.756	2.033
9	Pit 09	Pit 10	2/900	RRJ RCP - Class 2	1.01	6.55	1.983	1.917
10	Pit 10	Pit 11	2/900	RRJ RCP - Class 2	1.00	21.48	1.867	1.652
11	Pit 11	Pit 12	2/900	RRJ RCP - Class 2	1.00	21.48	1.602	1.388
12	Pit 12	Headwall	2/900	RRJ RCP - Class 2	1.00	12.50	1.338	1.213

Attachment 004:
COST ESTIMATE
Option 2

Item	Description of Works	Quantity	Unit	Rate	Amount
1 GENERAL					
1.1	Site establishment, setting up, setting out works, insurances, fees.	Item	Lump Sum	\$15,000	\$15,000
1.2	Liaison with relevant Services Authorities and locate Services	Item	Lump Sum	\$1,500	\$1,500
1.3	Prepare and Implement Traffic Management Plan	Item	Lump Sum	\$10,000	\$10,000
1.4	Prepare and Implement Environmental Management System including Sedimentation Control	Item	Lump Sum	\$6,000	\$6,000
1.5	Provision of temporary site facilities	Item	Lump Sum	\$1,000	\$1,000
2 PRELIMINARY					
2.1	Remove and Dispose of Existing Outlet	Item	Lump Sum	\$1,500	\$1,500
2.2	Clearing and Grubbing	Item	Lump Sum	\$2,400	\$2,400
3 EARTHWORKS					
3.1	Removal and stockpiling of topsoil (nominally 100mm)	2,150	m ²	\$1	\$2,365
3.2	Excavate, haul and dispose within 250m from site of material from trench area in accordance to Contract Drawings	2,700	BCM	\$50	\$135,000
3.3	Excavate and trim to design profile channel at location shown in Contract Drawings (Provisional Quantities)	150	BCM	\$50	\$7,500
3.4	Extra over item for removal of unsuitable material (Provisional Quantities)	100	BCM	\$80	\$8,000
3.5	Supply, load, and compact selected material for Bed and Haunch zone (type HS support)	310	CCM	\$67	\$20,770
3.6	Supply, load, and compact select material for Side zone and Overlay zone (Type HS support)	420	CCM	\$67	\$28,140
3.7	Win from borrow, load, and compact general backfill material for Overlay zone	630	CCM	\$45	\$28,350
4 STORMWATER PITS AND PIPES					
4.1	Cast Insitu new pit in accordance with Contract Drawings:				
	a) modified RTA pit type SA2	5	No.	\$1,820	\$9,100
	b) modified RTA pit type SA5	2	No.	\$1,860	\$3,720
	c) modified RTA pit type SO1	2	No.	\$1,980	\$3,960
	d) modified RTA pit type SO2	3	No.	\$3,000	\$9,000
4.2	Supply and place RCP class 2 RRJ in accordance with Contract Drawings:				
	a) 750mm dia. Pipe	430	m	\$148	\$63,640
	b) 900mm dia. Pipe	537	m	\$220	\$118,140
4.3	Supply, place and secure a precast headwall for 2/900mm dia. RCP at the location shown in Contract Drawings.	1	No.	\$1,200	\$1,200
4.4	Cast Insitu Kerb and Gutter type SA along Lighthouse Road upgrade (including connection to pits)	60	m ³	\$450	\$27,000
4.5	Cast Insitu Dish drain type SO along Massinger Street (including connection to pits)	14	m ³	\$450	\$6,300
4.6	Fabricate, supply and install drainage grate for SA2 pit type	5	No.	\$535	\$2,675
4.7	Fabricate, supply and install drainage grate for SA5 pit type	2	No.	\$535	\$1,070
4.8	Fabricate, supply and install drainage grate for SO1 pit type	2	No.	\$580	\$1,160
4.9	Fabricate, supply and install drainage grate for SO2 pit type	3	No.	\$965	\$2,895
5 DRAINAGE STRUCTURES					
5.1	Supply, place and secure BIDIM A34 geotextile underneath rock mattresses at downstream location of 600mm dia. precast headwall	30	m ²	\$8	\$240
5.2	Supply, place and secure 170mm thick RENO rock mattresses at the downstream location of 600mm dia. precast headwall	24	m ²	\$45	\$1,080
6 PAVEMENT (BY OTHERS)					
7 VEGETATION					
7.1	Topsoil and seed	650	m ²	\$1	\$455
8 MISCELLANEOUS					
8.1	Geotechnical inspections and certificate of compliance for fill materials.	Item	Lump Sum	\$2,500	\$2,500
8.2	Re-instate Existing Driveways	Item	Lump Sum	\$2,000	\$2,000
TOTAL COST					\$523,660
CONTINGENCY (20%)					\$104,732
GRAND TOTAL					\$628,392

Notes : BCM = Bank Cubic Metres
CCM = Compacted Cubic Metres